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Commentary

Management of PCB Accidents

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The purpose of this brief note is to bring together present ideas on the prevention and management of PCB accidents. In part, this summary is based on the papers presented in the Espoo symposium, in part, it reflects our own experience on PCB accidents. Some of these matters were discussed in the Espoo meeting; however, the views presented do not represent any consensus of the participants. The present authors are solely responsible for these opinions.

The primary goal in the management of PCB accidents is certainly prevention. To a certain extent, this goal will be achieved by exchange of PCB-containing transformers and capacitors. This, however, will only be reached in the long run; one has also to remember that the disposal of PCBs and electric devices containing them is a major problem. In addition, the safety, including fire resistance, of the substitutes has to be verified. It thus seems that PCB-containing electric appliances will be around for a long time. Of course, this is especially true of the millions of small electric appliances containing minute amounts of PCBs.

Meanwhile, the secondary approach in prevention is prevention of PCB fires. PCB-containing equipment has to be localized; function and condition of such equipment must be regularly checked. Electric countermeasures have to be taken in order to prevent overload and harmonic currents. PCB-containing capacitors have to be situated separately from capacitors containing mineral oils. The fire burden of the locations with PCB devices has to be minimized.

Even these countermeasures will probably turn out to be insufficient, therefore one must make sure that the damage of an incidental PCB fire is limited. The spread of soot and fumes has to be limited. This may be achieved by separating the air conditioning system of the space containing the electric devices from that of the rest of the building.

Prevention of human exposure and health hazards in PCB accidents relies very much upon the awareness of everyone concerned of the possibility of this hazard. Thus fire brigades have to be aware of the PCB hazards in general, as well as location of all major PCB-containing equipment in their area. The awareness of fire brigades of PCB hazards is extremely important also because what may originally be a minor incident in which pyrosynthetic derivatives are generated may be expanded to a large-scale catastrophe, e.g., by inadvertent clearing of smoke from the focal point to other parts of the building.

When appraising an accident involving electrical equipment, it should first be determined whether the equipment contained PCBs, polychlorinated benzenes, or poly-chlorinated terphenyls and second, whether PCBs have been heated. When information on PCB hazards is disseminated, it becomes evident that most incidents involving PCBs are simple leaks of minor or major amounts of PCBs from condensors. In these cases, although careful decontamination is needed, the health risks probably are not very marked. If there is a possibility that PCBs have been heated (in fire or electric arc), there is always the possibility of formation of pyrosynthetic products and a possibility of health effect. In these cases, (1) the health of the fire brigade has to be protected, and pressurized respirators and protective suits have to be worn; (2) the contamination has to be contained, and the risk area must be closed. In this phase, the area to be closed off is an educated guess as no analytical results are available. The closed area must include not only the immediate focal point, but also the routes the exhaust gases have taken. When other hazards (fire, electricity, falling ceilings, walls) permit, the formation of pyrosynthetic products from PCBs and their extent of contamination must be verified and investigated. At present this is best done from sweep specimens of the surfaces. The selection of sampling spots needs skilled industrial hygienist, preferably with experience with PCB accidents. The collection of the specimens urgently needs standardization, as does specimen processing for the analysis and the analytical methods themselves. It is preferable to analyze both PCBs and the pyrosynthetic products. In the latter case, high resolution gas chromatography/ mass spectrometry, in experienced hands, is required. One must be capable of isomer-specific analysis of tetra-and pentachlorodibenzodioxins and -furans.

The number of laboratories presently capable of achieving this is not great. The demand of analyses, however, is increasing. In 1984, the U. S. Environ-

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mental Protection Agency began a quality assurance activity of the analyses of these compounds. It is a very timely and an extremely important project. There is also an urgent need to develop these analytical capabilities in different laboratories, as not only the quality of the analysis is important but also the speed plays an important role: every minute of down time costs money. The analyses are needed not only immediately after the accident, but also in the follow-up of the cleaning work afterwards. Although the marked toxicity of polychlorodibenzofurans and -dioxins is well known, there is little information on their health effects in capacitor and transformer accidents. It seems, however, reasonable that persons (potentially) exposed in these accidents are recorded their exposure is verified, and a simple follow-up is made. The exposure may be verified from determinations of PCB levels in the serum; should these or the amounts of pyrosynthetic products generated in the accident (as revealed by the environmental monitoring) be high, it would be advisable to analyze serum and adipose tissue for the pertinent chlorodibenzofuran or -dioxin isomers. To us it would seem that it is advisable also to record changes in liver function (aminotransferases, glutamyltransferase), and in the metabolism of lipids (serum cholesterol and triglycerides). Ill-defined effects of chlorodibenzofurans and -dioxins include changes in immune response and peripheral nervous changes. These may be followed by studying changes in lymphocyte population and the functions of the lymphocytes, or measuring nerve conduction velocities.

Clean-up procedures have not yet been established. The most widely used measures taken have included vacuum cleaning (with microfilter-fitted vacuum cleaners), pressure washing, washing with organic solvents. In some cases these have not been judged sufficient; complete floor surfaces have been removed, laid with concrete, and covered with epoxy paints. The efficiency of painting as a protective measure still remains to be established: there are hints that the furans and PCB itself might migrate through the epoxy to the surface afterwards.

Another open question is, what are acceptable levels of residues of chlorodibenzodioxins and -furans or their isomers in the air or on surfaces after the cleaning. With surfaces there is the additional problem of representativeness: the analytical results from one spot to another might differ by orders of magnitude. In Sweden an inofficial limit of 50, 100 and 1000 ng/m^2 for 2,3,7,8-tetrachlorodibenzofuran, total tetrachloro-and poly (4-8) chlorodibenzofurans have been suggested. In Finland, we have selected 2,3,7,8-tetrachlorodibenzofuran as the indicator chemical (as the quantitation methods are easiest for this single compound), and the authorities have used 5 ng/m^2 as the limit. This is based on selection of the most contaminated site for sampling by an experienced industrial hygienist.